

A new genus of large Vesicomysidae (Mollusca, Bivalvia, Vesicomysidae, Pliocardiinae) from the Congo margin, with the first record of the subfamily Pliocardiinae in the Bay of Biscay (northeastern Atlantic)

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ABSTRACT

A new genus in the subfamily Pliocardiinae (Vesicomysidae), *Christineconcha* n. gen., is established for "*Calyptogena*" *regab* Cosel & Olu, 2009. The most characteristic features of *Christineconcha* n. gen. are a rather thin and elongate shell up to 122 mm in length, a pallial line starting from the ventral margin of the anterior adductor scar, the presence of the inner demibranch only and the absence of the pallial fusion between the pedal gape and the inhalent siphon. Morphologically, *Christineconcha* is closest to the genus *Abyssogena* Krylova & Sahling, 2010. The monospecific new genus occurs in the Atlantic on the continental margin of Africa and Europe, from the Gulf of Guinea to the southern Bay of Biscay, at depths of 2820-4017 m. In the Gulf of Guinea, *Christineconcha* n. gen. is recorded from cold seeps; in the Bay of Biscay, the record of *C. regab* n. comb. indicates the likely presence of reducing biotopes. Morphological basis for the slightly different ecological niches of the co-occurring species *Christineconcha regab* n. comb. and *Laubiericoncha chuni* (Thiele & Jaeckel, 1931) is discussed.

KEYWORDS

Mollusca,
Bivalvia,
Vesicomysidae,
Pliocardiinae,
cold seeps,
Gulf of Guinea,
eastern Atlantic,
Bay of Biscay,
new genus.

RÉSUMÉ

Un nouveau genre de grands Vesicomysidae (Mollusca, Bivalvia, Vesicomysidae, Pliocardiinae) de la marge du Congo, et première observation de la sous-famille Pliocardiinae dans le golfe de Gascogne (nord-est Atlantique).

Un nouveau genre, *Christineconcha* n. gen., est établi dans la sous-famille Pliocardiinae (Vesicomysidae) pour "*Calypptogena*" *regab* Cosel & Olu, 2009. Les traits les plus caractéristiques sont une coquille assez mince et allongée, jusqu'à 122 mm de longueur, la ligne palléale débutant à la marge ventrale de l'empreinte de l'adducteur postérieur, la présence du seul demibranche intérieur et l'absence d'une fusion palléale entre l'ouverture pédale et le siphon inhalant. Du point de vue morphologique, *Christineconcha* n. gen. est plus proche du genre *Abyssogena* Krylova & Sahling, 2010. Le nouveau genre, monospécifique, vit dans l'Atlantique sur la marge continentale de l'Afrique et de l'Europe, entre le golfe de Guinée et la partie sud du golfe de Gascogne, entre 2820 et 4017 m de profondeur. Dans le golfe de Guinée, *Christineconcha* n. gen. a été recolté sur des suintements froids; dans le golfe de Gascogne, l'observation de *C. regab* n. comb. indique la présence probable d'environnements réducteurs. Les deux espèces *Christineconcha regab* n. comb. et *Laubiericoncha chuni* (Thiele & Jaekel, 1931) sont sympatriques, mais occupent deux niches écologiques légèrement différentes, ce qui est discuté en relation avec leur morphologie.

MOTS CLÉS

Mollusca,
Bivalvia,
Vesicomysidae,
Pliocardiinae,
suintements froids,
golfe de Guinée,
Atlantique oriental,
golfe de Gascogne,
genre nouveau.

INTRODUCTION

During the IFREMER-TOTAL multidisciplinary collaboration projects ZAIANGO and BIOZAIRE on the equatorial West African margin off the coasts of Gabon, Congo and northern Angola and in the vicinity of the Congo channel, studies of the biological communities (Olu-Le Roy *et al.* 2007; Sibuet & Vangriesheim 2009) resulted in the discovery of a rich fauna of vesicomysid bivalves (Cosel & Olu 2008, 2009). Altogether eight species from five genera were recorded, among them three new species and two new genera (Cosel & Olu 2009). The new species from the REGAB pockmark, a cold seep site, "*Calypptogena*" (s.l.) *regab* Cosel & Olu, 2009, did not fit any known generic diagnosis and was only provisionally assigned to *Calypptogena* Dall, 1891. Herein, mostly based on soft anatomy, we propose a new genus, related to the other large- and medium-sized vesicomysids which harbour sulphide-oxidizing bacteria in the subfilamental tissue of their gills and which have a reduced gut. Like these the new genus is included in the subfamily Pliocardiinae Woodring, 1925 (Krylova & Sahling 2010).

In the northeastern Atlantic, the new genus was recorded from the Gulf of Gascony in the southern part of the Bay of Biscay (this paper) and from the Gulf of Cadiz (C. F. Rodrigues & M. R. Cunha pers. comm.), which are the first records of large vesicomysids in this area.

MATERIAL AND METHODS

The material (live-taken specimens and empty shells and valves) of "*Calypptogena*" (s.l.) *regab* was collected during five oceanographic expeditions (Table 1) with the ROV *Victor 6000* and by means of a 6 m beam trawl and an USNEL type box corer. The taxa used for comparison are listed in Table 2. The denomination of the hinge teeth (Fig. 7E-F) follows recent literature on the vesicomysids (Horikoshi 1989; Okutani *et al.* 2000; Krylova & Sahling 2006; Cosel & Olu 2009). Gross anatomy was observed on preserved specimens.

The localities on the equatorial West African margin are described in Cosel & Olu (2009).

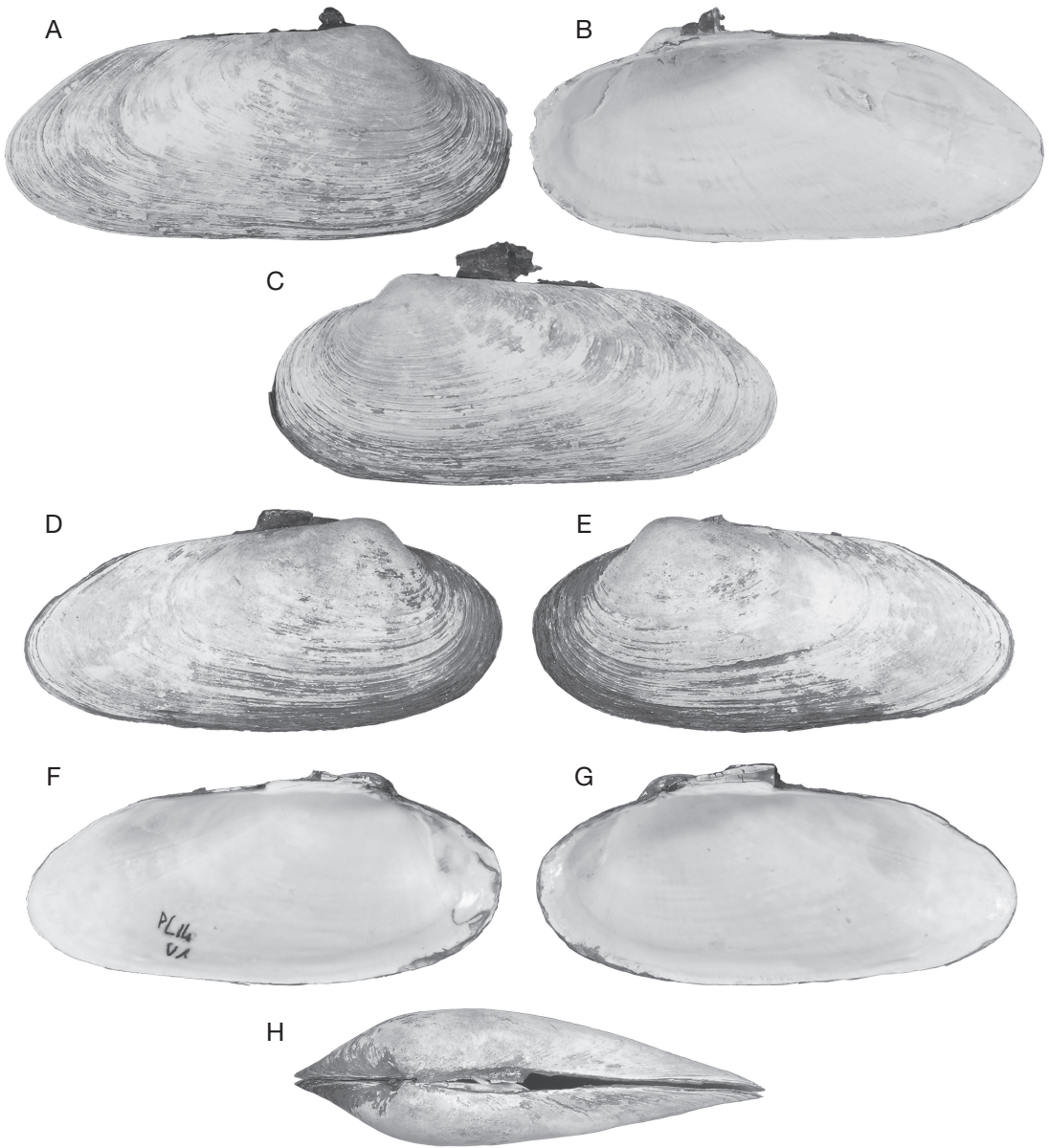


FIG. 1. — *Christineconcha regab* (Cosel & Olu, 2009) n. comb.: **A-C**, 103.0 mm, REGAB site, 5°46.89'S, 9°44.65'E, 3159-3113 m, BIOZAIRE 3, trawled RV *Atalante*, CP 20, 2.I. 2004; **A**, exterior of rv; **B**, interior of rv; **C**, exterior of lv; **D-H**, holotype MNHN, 95.6 mm, N of Congo Canyon, 5°57.85'S, 9°42.7'E, 3140-3170 m REGAB site, ZAIROV 2, ROV PL 14 (GBT2); **D**, exterior of rv; **E**, exterior of lv; **F**, interior of lv; **G**, interior of rv; **H**, dorsal view. Abbreviations: see Material and methods.

TABLE 1. — *Christineconcha regab* n. comb. (Cosel & Olu, 2009), material examined.

Research programm	Year	Station	Material	Area
BIOGAS IV (P. I.: L. Laubier)	1974	Trawled RV <i>Jean Charcot</i> , DS 55, stn 3, 47°34.9'N, 9°40.9'W, 4125 m	1 spm	NE Atlantic, Gulf of Biscay
ZAIROV 2 (P. I.: H. Ondréas)	2000-2001	RV <i>Atalante</i> , ROV PL 73-13, 4°57'S, 10°09.5'E, 2820-2840 m	2 old v	Tropical eastern Atlantic, north of Congo channel, ASTRID site
BIOZAIRE 1 (P. I.: M. Sibuet)	2001	ROV PL 74-14, 5°57.85'S, 9°42.7'E, 3140-3170 m	1 spm MNHN 20542 (holotype)	North of Congo channel, REGAB site
BIOZAIRE 2 (P. I.: M. Sibuet)	2001	RV <i>Atalante</i> , ROV PL 81-5, 5°47.89'S, 9°42.64'E, 3151-3159 m	1 spm, 1 v, MNHN 20544 (paratypes)	North of Congo channel, REGAB site
		RV <i>Atalante</i> , ROV PL 147, 5°47.78'S, 9°42.65'E, 3151-3159 m	1 spm, 4 sh, 1 v MNHN 20543 (paratypes)	North of Congo channel, REGAB site
		ROV PL 148-5, 5°47.98'S, 9°42.47'E, 3152-3151 m	2 sh	
BIOZAIRE 3 (P. I.: A. Khripounoff)	2003-2004	Trawled RV <i>Atalante</i> , CP 14, 7°42.41'S, 10°08.39'E, 4001-4017 m	Broken v	Off north Angola, west of Ambrizete
		Trawled RV <i>Atalante</i> , CP 19, 5°48.07'S, 9°41.61'E, 3155-3184 m	2 sh, fragments	North of Congo channel, REGAB site
		Trawled RV <i>Atalante</i> , CP 20, 5°47.78'S, 9°42.65'E, 3151-3159 m	Numerous sh and v, MNHN 20546 (paratypes and associated specimens)	

ABBREVIATIONS

Repositories

MNHN	Muséum national d'Histoire naturelle, Paris;
NMB	Naturhistorisches Museum Basel;
SMF	Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main;
USNM	National Museum of Natural History, Smithsonian Institution, Washington, DC.

Anatomy

aa	anterior adductor;
al	ascending lamella of demibranch;
alp	anterior labial palps;
apn	anterior pallial nerve;
apr	anterior pedal retractor muscle;
au	auricle;
apv	attachment to visceral mass;
ba	byssus aperture;
dl	descending lamella of demibranch;
dm	dorsal margin;
es	exhalent siphon;
f	foot;
fg	food groove;
fmm	fused mantle margin;
fs	foot stem;

gf

hg

ils

ioes

is

iss

iv

le

lmis

lv

m

mm

mme

mo

pc

pg

plp

ppr

r-pa

rv

sh

sm

spm

sr

st

gill filament;

hindgut;

interlamellar septum, composed of separate tubes (st);

inner opening of exhalent siphon;

inhalent siphon;

intersiphonal septum;

inner vulva of inhalent siphon;

lateral extension of foot;

lateral margin of inhalent siphon;

left valve;

mouth;

mantle margin;

mantle muscularised envelope;

mouth;

pericardial cavity;

pericardial glands;

posterior labial palps;

posterior pedal retractor;

reno-pericardial aperture;

right valve;

empty shell (both valves);

muscles of siphonal wall;

live-collected specimen(s);

siphonal retractor;

separate tubes;

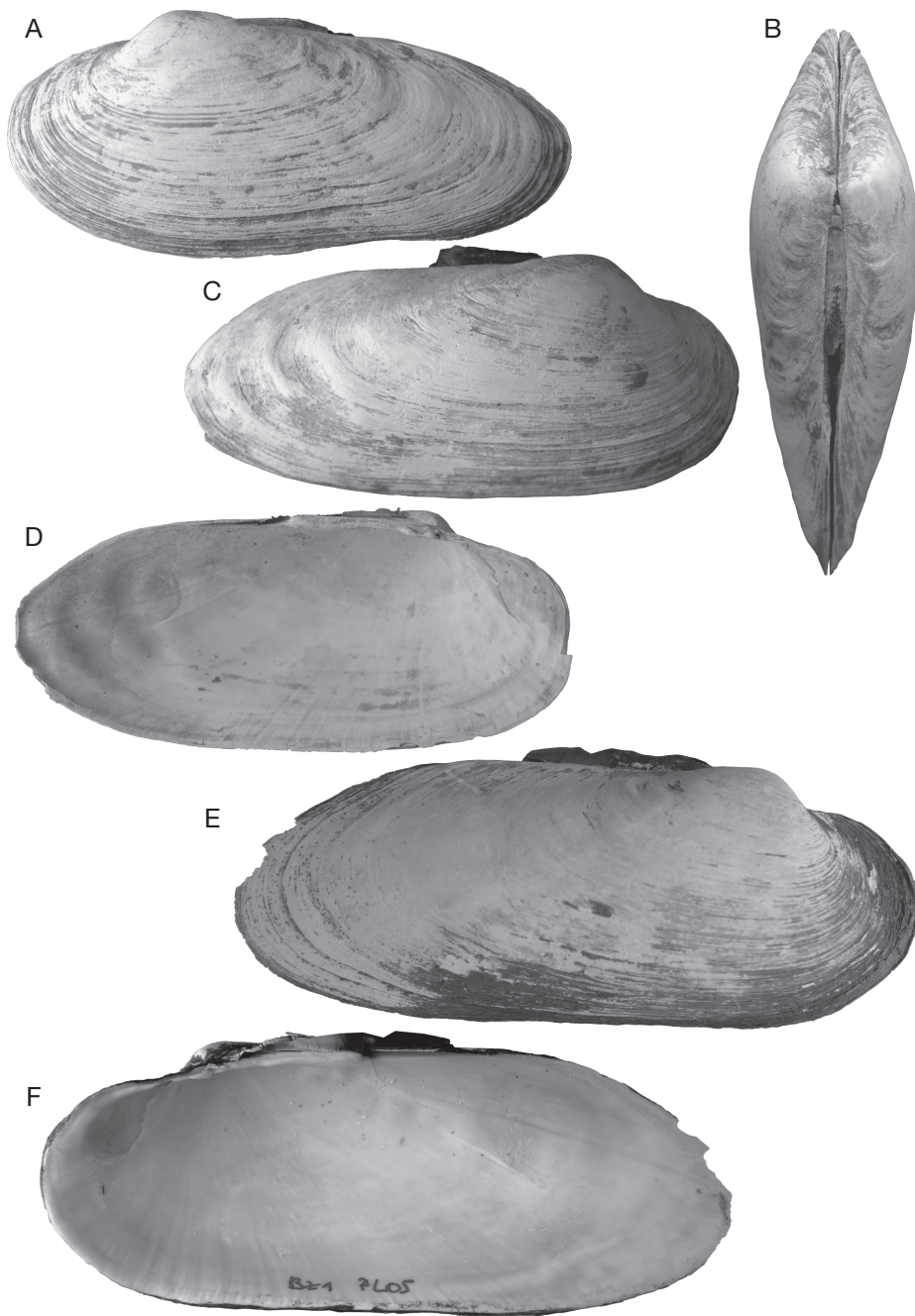


FIG. 2. — *Christineconcha regab* (Cosel & Olu, 2009) n. comb.: **A, B**, 103.7 mm, N of Congo Canyon, REGAB site, 5°46.89'S, 9°44.65'E, 3159-3113 m, BIOZAIRE 3, trawled RV *Atalante*, stn CP 20, 2.I.2004; **A**, exterior of lv; **B**, dorsal view; **C, D**, 100.1 mm, same locality; **C**, exterior of rv; **D**, interior of lv (note the wavy sculpture of the posterior third of the valves); **E, F**, paratype MNHN, 122.2 mm, N of Congo Canyon, REGAB site, 5°47.89'S, 9°42.64'E, 3151-3127 m, BIOZAIRE 1, ROV PL 81-5; **E**, exterior of rv; **F**, interior of rv. Abbreviations: see Material and methods.

TABLE 2. — Material examined of other species of Vesicomysidae.

Species	Source of the material
<i>Ectenagena elongata</i> (Dall, 1916)	Albatross, St. 4432, off Point Loma, California, 275 fm (502 m), type material, USNM 110774.
<i>Abyssogena kaikoi</i> (Okutani & Métivier, 1986)	KAIKO, Nautila, KD-5, 33°36.9'N, 137°32.0'E, 3830 m, 10 June 1985, Tenryu Submarine Canyon, Nankai Trough, West Pacific, holotype, MNHN.
<i>Abyssogena southwardae</i> Krylova, Sahling & Janssen, 2010	RV Meteor- 64/1, St. 125, ROV 7, 04°48.65' S, 12°22.35' W 2985 m, 12 April 2005, MAR, Widawake Mussel Field, holotype, SMF 331775.
	BARENAUT, PL 94, 13°49' N, 59°37' W, 4935 m, 24 Sept. 1987, Western Atlantic, Barbados accretionary prism.
<i>Pleurophopsis unioides</i> Van Winkle, 1919	Miocene, Trinidad, NMB 185, 186.

tcg tissue, connecting ventral parts of ascending lamella behind the foot;
tis tentacles of the inhalent siphon;
umm unfused mantle margin;
v single valve(s);
vn ventricle;
vm ventral margin;
vt vascularized thickening.

Other abbreviations

CP beam trawl [chalut à perche];
MAR Mid-Atlantic Ridge;
PL dive [plongée];
RV research vessel;
ROV remote-operated vehicle;
stn station.

SYSTEMATICS

Order VENEROIDA

H. Adams & A. Adams, 1856
Superfamily GLOSSOIDEA Gray, 1847

Family VESICOMYIDAE Dall & Simpson, 1901

Vesicomysidae Dall & Simpson, 1901: 496 [original spelling].

Vesicomysidae – Keen 1969: 664 [corrected spelling].

Subfamily PLIOCARDIINAE Woodring, 1925

Pliocardiinae – Krylova & Sahling 2010: 5.

Genus *Christineconcha* n. gen.

Genus N 2 – Krylova & Sahling 2010: 6.

TYPE SPECIES. — “*Calyptogena*” (s.l.) *regab* Cosel & Olu, 2009.

SPECIES INCLUDED. — The type species only.

ETYMOLOGY. — This new genus is dedicated to the daughter of the second author, Marie Christine von Cosel; gender feminine.

DISTRIBUTION. — Eastern Atlantic along the Equatorial African margin, off northern Angola and north of the Congo Canyon, there only known from the two pockmarks REGAB and ASTRID, from 2820 to 4017 m (Cosel & Olu 2009); in the Bay of Biscay (Gulf of Gascony), 4125 m (Table 1) and also in the Gulf of Cadiz, 3060 m (C. F. Rodrigues & M. R. Cunha pers. comm.).

DIAGNOSIS. — Shell rather large, to 122 mm long, thin-shelled and fragile, elongate-oval, quite variable in outline, with usually convex ventral margin, occasionally straight or slightly concave in its middle part. Anterior margin broadly rounded, posterior margin tapering and more or less narrowly rounded in the middle or more posterior-ventrally. Surface chalky, with fine and dense, irregular commarginal striae and small lamellae and growth lines. Extremely shallow and hardly visible escutcheon limited by sharp ridge, lunular incision missing. Posterior angle (between beaks and posterior margin) very broad and rounded, weak to obsolete. On the posterior third or fourth of the valve often broad, wave-like commarginal undulations which cross the posterior angle. Periostracum rather thin, dark brownish, dull, eroded, persistent on the antero-ventral part of the valves, where it becomes somewhat leafy near the margins. Pallial line close to the ventral margin,

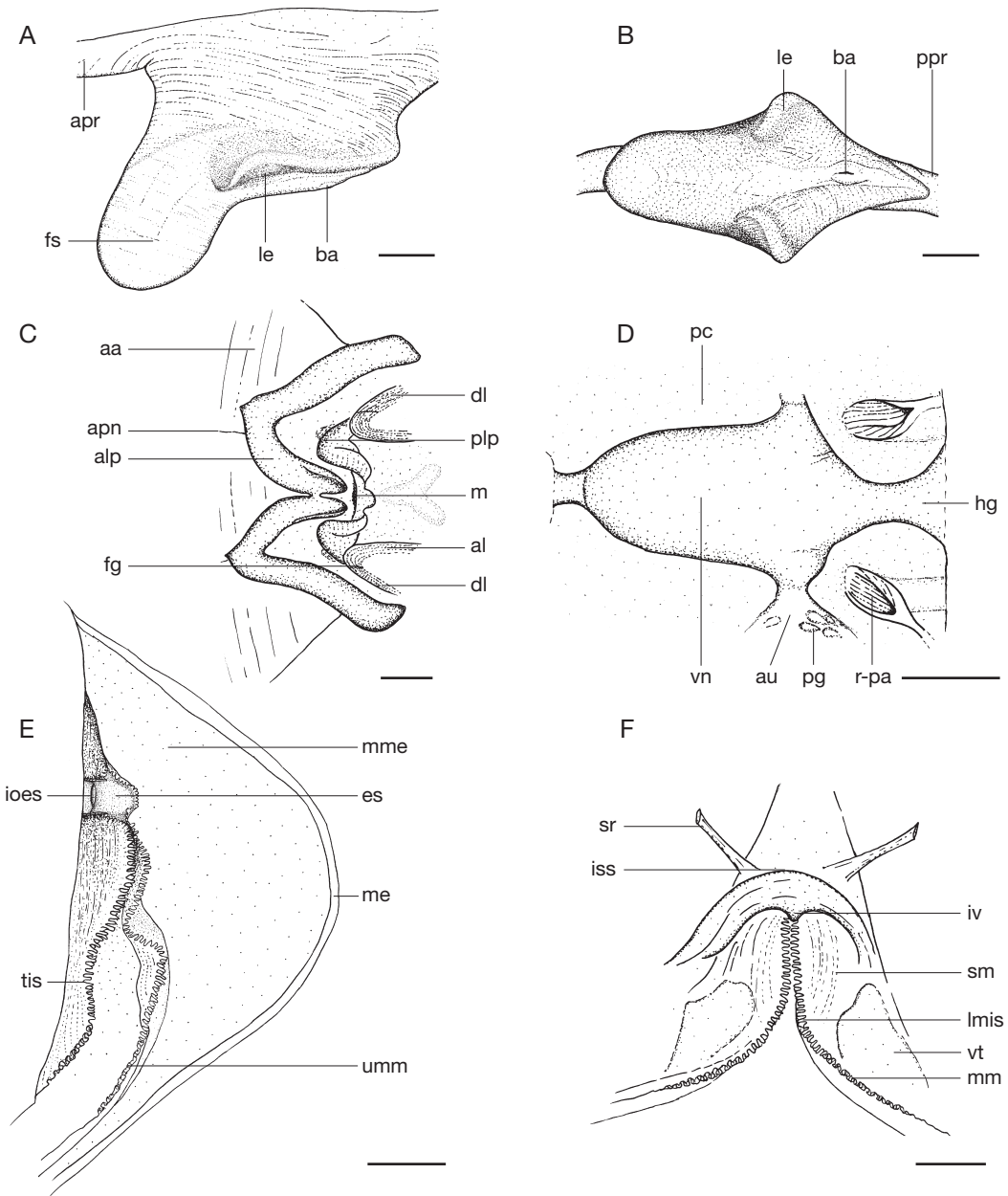


FIG. 3. — *Christineconcha regab* (Cosel & Olu, 2009) n. comb. anatomical details: **A**, lateral view of foot from the left; **B**, ventral view of foot; **C**, ventral view of labial palps; **D**, heart; **E**, lateral view of siphons from the left, part of left mantle lobe removed; **F**, interior view of inhalent siphon. Abbreviations: see Material and methods. Scale bars: A-C, E, F, 5 mm; D, 1 mm.

starting from the middle of the ventral margin of the anterior adductor scar; pallial sinus absent but pallial line in its posterior part slightly irregular. Dorsally to

the pallial line a few small secondary pallial attachment scars arranged along the anterior 2 to 3 cm of the pallial line or its whole length in adult specimens (see Fig. 7C).

TABLE 3. — Some characters of vesicomyid genera with elongate shell shape.

	<i>Christineconcha</i> n. gen.	<i>Abyssogena</i> Krylova, Sahling & Janssen, 2010	<i>Ectenagena</i> Woodring, 1938	<i>Adulomya</i> Kuroda, 1931	<i>Pleurophopsis</i> Van Winkle, 1919
Type species	<i>Christineconcha</i> <i>regab</i> n. comb. (Cosel & Olu, 2009)	<i>Abyssogena</i> <i>southwardae</i> Krylova, Sahling & Janssen, 2010	<i>Calyptogena</i> <i>elongata</i> Dall, 1916	<i>Adulomya</i> <i>uchimuraensis</i> Kuroda, 1931	<i>Pleurophopsis</i> <i>unioides</i> Van Winkle, 1919
Maximal shell size (in mm)	122	277.4	44	179.6	200
Subumbonal pit	Absent	Absent	Present	Present	Absent
Start of pallial line	From ventral margin of anterior adductor scar	From ventral margin of anterior adductor scar	From posterior margin of anterior adductor scar	From posterior margin of anterior adductor scar	From posterior margin of anterior adductor scar
Pallial sinus	Absent	Very small irregular indentation	Absent	Absent	Absent
4b tooth	Not reduced compared to the other left teeth	Absent or developed less than the other left teeth	Developed less than the other left teeth	Not reduced compared to the other left teeth	?
Number of demibranchs	1	1	2	?	?
Fusion of the ventral mantle margins of the inner siphon	Absent	Present	Present	?	?

Anterior adductor scar elongate in dorso-ventral direction, drop-shaped, its posterior margin somewhat impressed. Anterior pedal retractor scar irregularly elongate, slightly impressed, just above and behind the anterior scar, fused with it but occasionally separate. Posterior adductor scar larger, rounded, almost circular, fused with the posterior pedal retractor scar. Ligament external, parivincular, opisthodontic, on a well developed nymphal plate. Anterior lamellar layer not creating subumbonal pit. Hinge plate narrow, teeth arrangement only slightly radiating. Right valve with rather strong and well-developed anterior ventral cardinal (1), almost parallel to the antero-dorsal margin and with its posterior end situated more or less beneath the umbo. Subumbonal cardinals 3a and 3b assumed to be fused, anterior cardinal 3a thin and short, its anterior end more or less directly under the tip of the umbo. Posterior cardinal 3b lower than (1), stronger than 3a, and in its posterior part parallel to the ventral margin of the hinge plate. Left valve with a rather thin and short, somewhat variable cardinal 2a ascending towards the umbo and reaching the subumbonal and stronger, triangular wedge-like posterior cardinal 2b. Postero-dorsal cardinal 4b more or less long, thin and radiating. Ctenidia with inner demibranchs only, with descending and ascending lamellae; interlamellar septa

divided into cylindrical channels. Ventral margin of the demibranch with very shallow food groove. Alimentary canal straight. Ventral margins of the mantle not fused forming the inhalent siphon. Inner valve of inhalent siphon without processes. Margins of inhalent siphon with close-set short tentacles on both sides towards antero-ventrally, then passing into the papillate inner mantle fold. For detailed description of the type species, see Cosel & Olu (2009).

REMARKS

Christineconcha n. gen. has a very characteristic anatomical feature that distinguishes it from all known vesicomyid genera: the mantle fusion forms two pallial apertures instead of three as in other vesicomyids, the pedal gape and the opening of the exhalent siphon only. There is no ventral mantle fusion under and in front of the inhalent siphon, that means that structurally the inhalent siphon is not separated from the pedal gape (Figs 3E, F; 5A, B; 6A). This “incomplete” siphon seems to be capable to function like a “normal” closed tubular siphon since

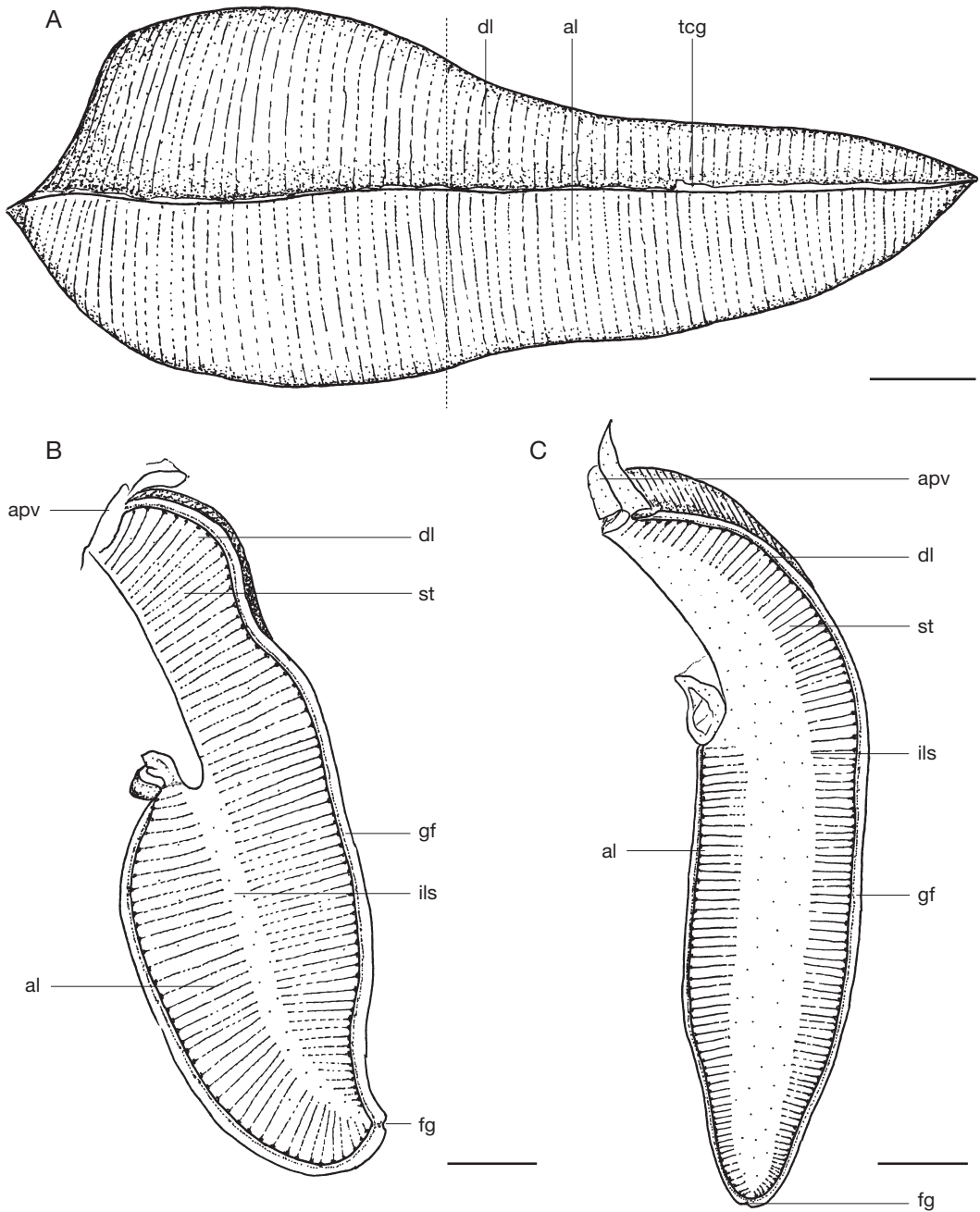


FIG. 4. — *Christineconcha regab* (Cosel & Olu, 2009) n. comb. ctenidia: **A**; lateral view of right gill from the inside; the dotted line represents the transverse sections of images **B** and **C**; **B**, **C**, transverse section through medial part of ctenidia; **B**, specimen from ROV Victor 6000 PL 74-14; **C**, specimen from RV Jean Charcot, DS 55, stn 3. Abbreviations: see Material and methods. Scale bars: A, 5 mm; B, C, 1 mm.

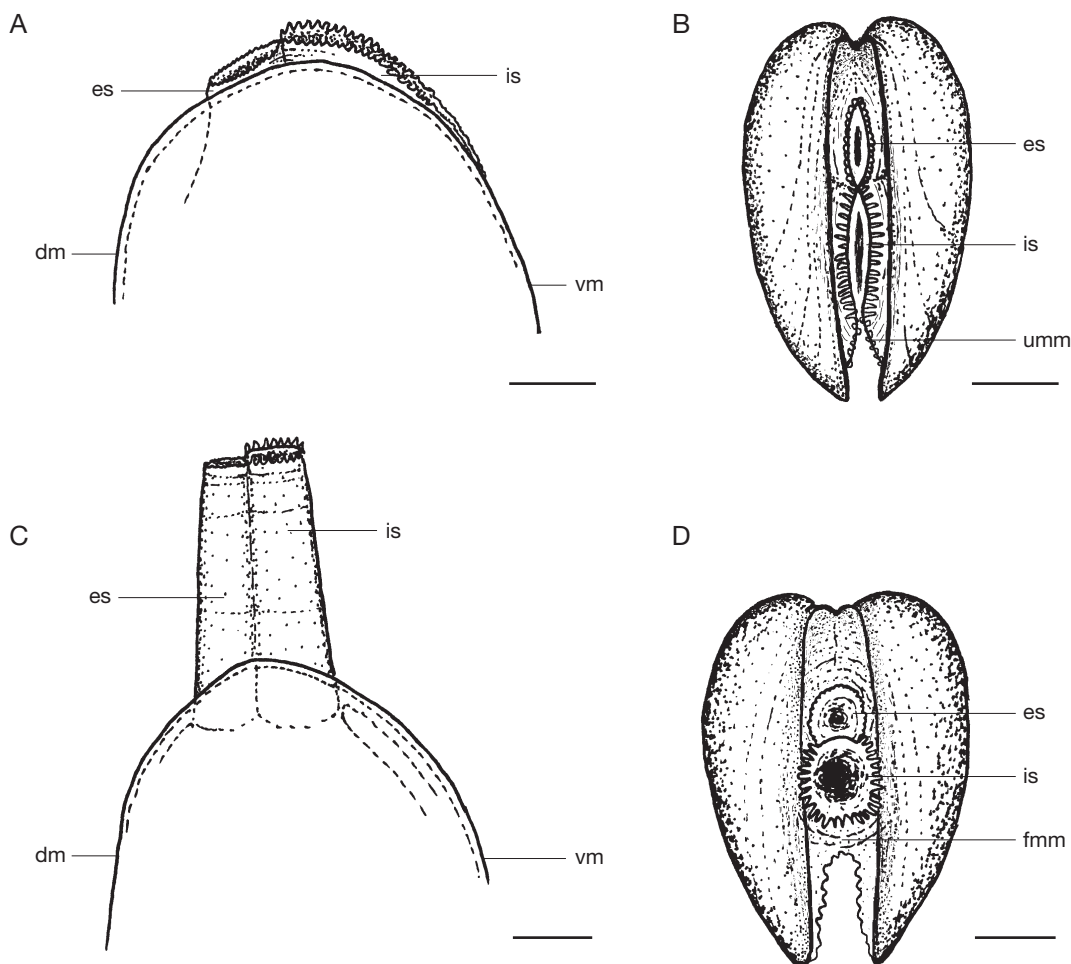


FIG. 5. — **A, B**, *Christineconcha regab* (Cosel & Olu, 2009) n. comb: **A**., posterior part of specimen from the left side; **B**., posterior view of siphons; **C, D**, *Laubiericoncha chuni* (Thiele & Jaeckel, 1931): **C**., posterior part of specimen from the left side; **D**., posterior view of siphons. Abbreviations: see Material and methods. Scale bars: 1 mm.

there is probably an obturative mechanism allowing to make a temporally functional tube (Fig. 5B). At the base of the inhalant aperture there is a strongly developed muscle band and additionally on the inner surfaces of the mantle lobes, vascularized thickenings are present, which obviously can be enlarged and reach each other, which means that this incomplete siphon is probably able to function by the formation of a temporary functional tube. In other respects there is no principal difference between the siphons of *C. regab* n. comb. and

“typical” vesicomyid siphons. Both siphons are very short, the inhalant siphon a little bit shorter; they are united over their entire length. The margins of both apertures bear 2-1 rows of small tentacles, those of the exhalant siphon are much shorter and look like papillae. The tentaculate margin of the inhalant siphon grades into the papillate margin of the pedal gape. Internally, the inhalant siphon has on its dorsal side a ventrally directed, triangular flap of vascularized tissue, and the exhalant siphon has a thin, short sleeve (Fig. 3E). A well-developed

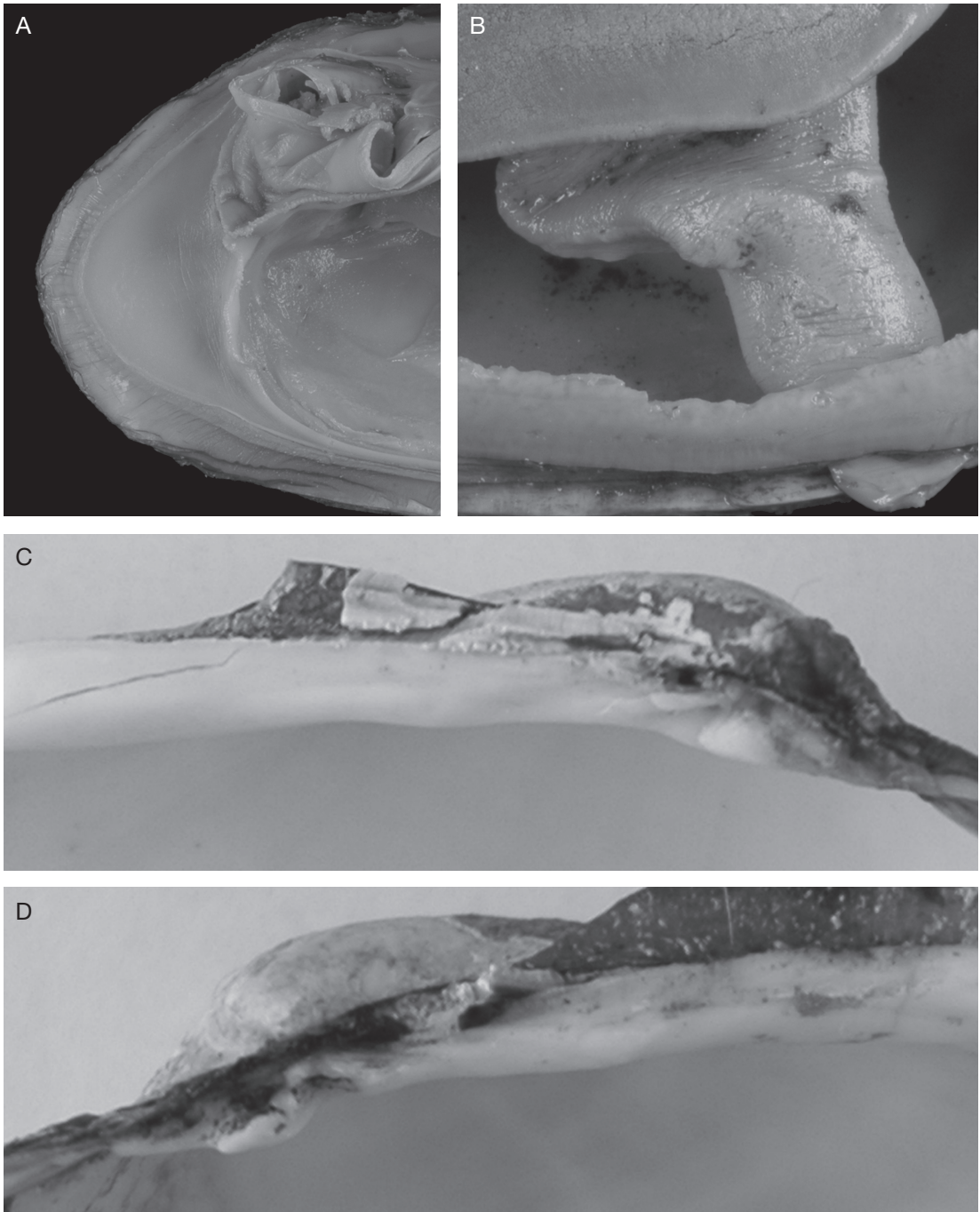


FIG. 6. — **A, B**, *Christineconcha regab* (Cosel & Olu, 2009) n. comb.: **A**, specimen from PL 147, BZ 2, SL 89.9 mm, posterior end with siphons, right mantle edge removed; **B**, paratype MNHN, PL 147, BZ 2, close-up view of foot with broadened base (both taken from Cosel & Olu 2009); **C, D**, hinges; **C**, hinge of rv, PL 147, 105.3 mm; **D**, hinge of lv of holotype. Abbreviations: see Material and methods.

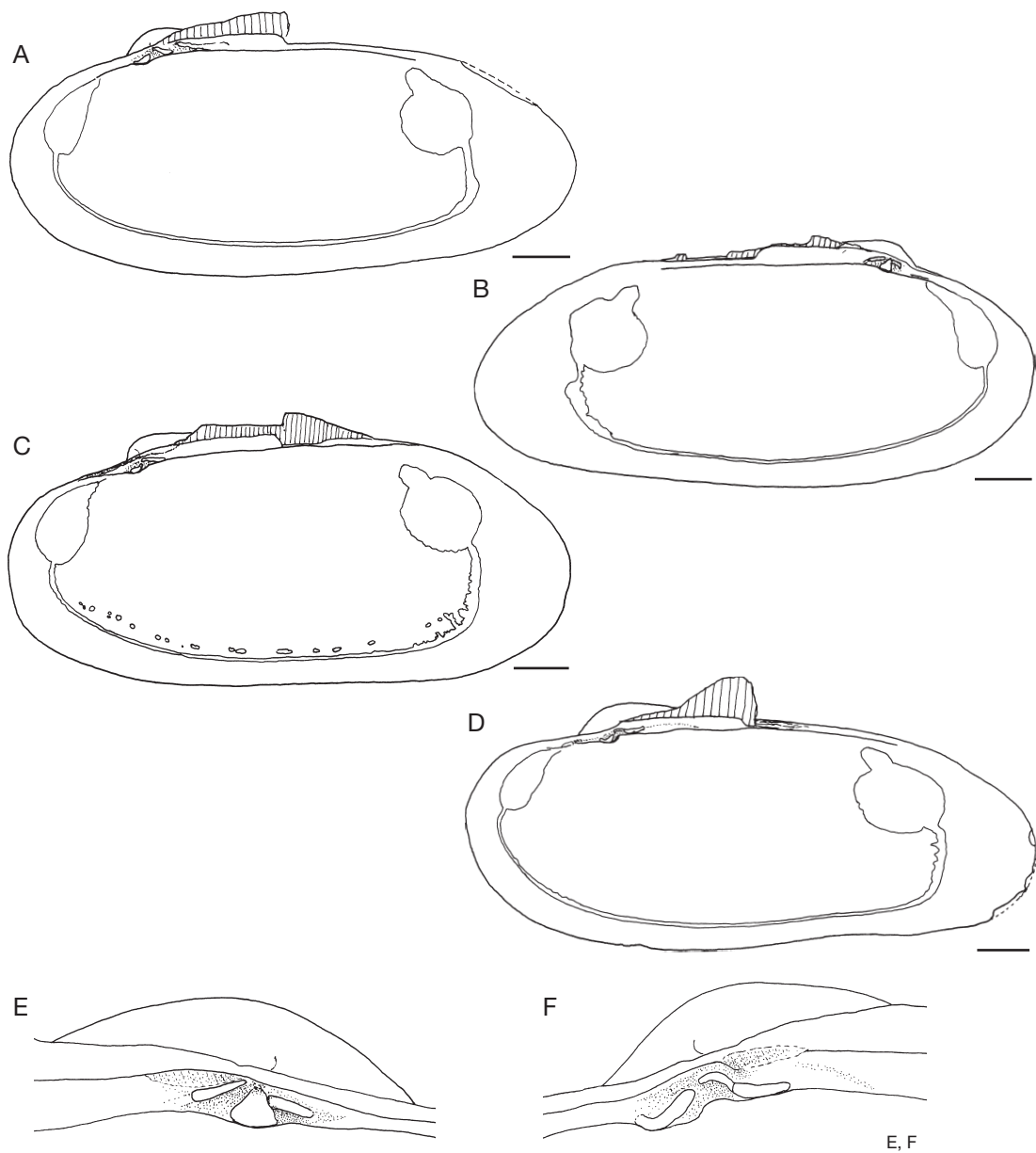


FIG. 7. — *Christineconcha regab* (Cosel & Olu, 2009) n. comb.: **A, D**, half-schematic drawings of valves; **A**, holotype, rv; **B**, holotype lv; **C**, paratype MNHN, BZ 2, ROV PL 147, SL 105.1 mm, rv (note the secondary scars above the pallial line); **D**, specimen from stn CP 20, BIOZAIRE 3, 107.1 mm, rv.; **E, F**, hinges of the holotype: **E**, lv; **F**, rv. Abbreviations: see Material and methods. Scale bars: 10 mm.

muscular septum is present between the siphons; the intersiphonal septal retractors are fused with the ventral surface of the posterior adductor.

Similar to other vesicomysids, the foot of *C. regab* n. comb. is well developed; posterior to the foot stem, lateral wing-like widenings, not recorded in vesico-

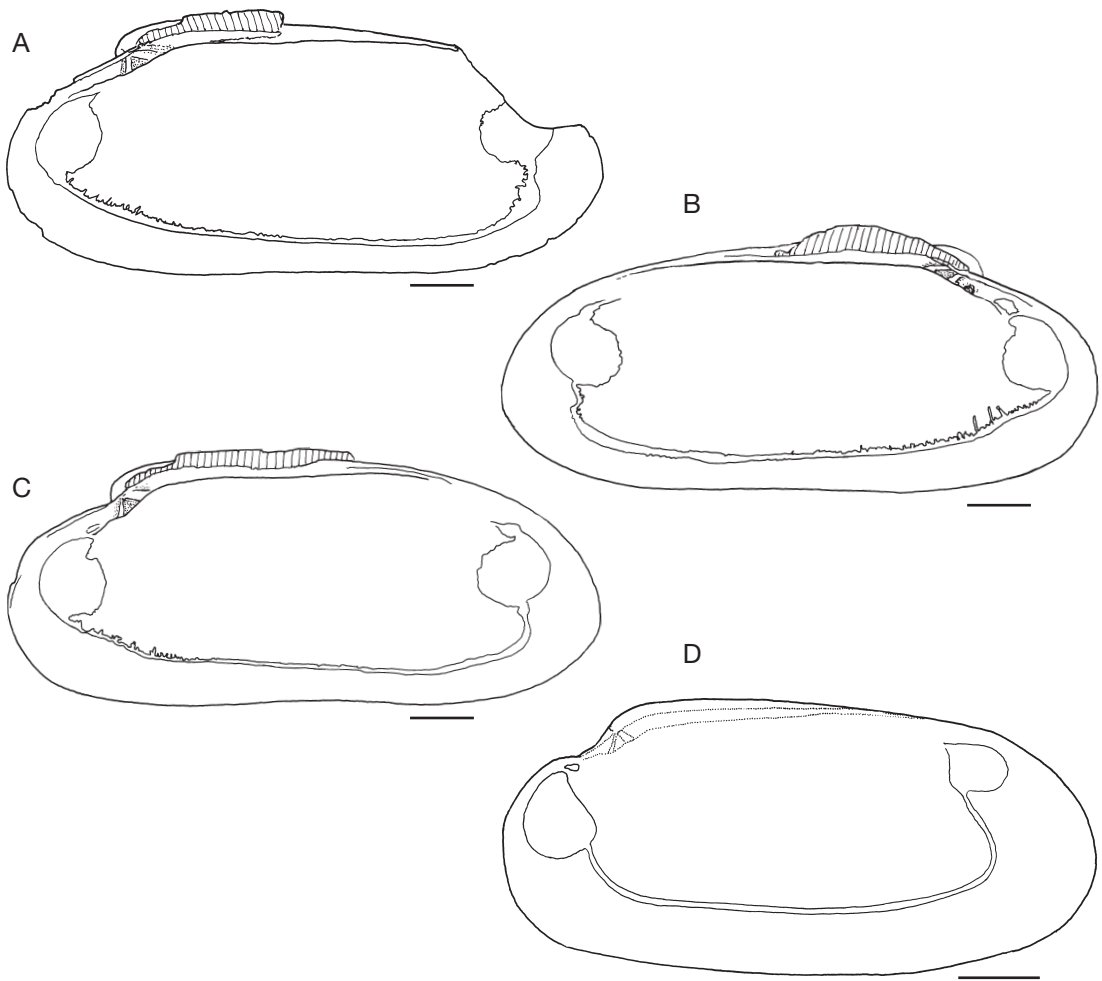


FIG. 8. — **A–C**, *Abyssosgena southwardae* Krylova, Sahling & Janssen 2010; **A, B**, Barbados accretionary prism, BARESNAUT, PL 94; **A**, rv; **B**, lv; **C**, same locality, PL 94B, rv; **D**, *Pleurophopsis unionides* Van Winkle, 1919, Miocene of Trinidad, composite drawing after internal mold. Abbreviations: see Material and methods. Scale bars: 10 mm.

myids before, are present (Figs 3A, B; 6B); there is no byssal groove but a small byssal aperture only.

The ctenidia of *C. regab* n. comb. (Fig. 4) are thick and non-plicate; they comprise the inner demibranch only, with descending and ascending lamellae; the ascending lamellae with half to two thirds the size of descending lamellae. The entire interlamellar space is filled with the interlamellar septum which is divided into separate cylindrical tubes at most parts or at full width within the septum.

BIOLOGY

Christineconcha regab n. comb. and *Laubiericoncha chuni* (Thiele & Jaeckel, 1931) are found on REGAB frequently in the same beds in more or less close agglomerations. On submarine photographs (Fig. 9B) they can be recognized at once by the entirely different form of the siphon: in *L. chuni*, they are fused, tubuliform and well visible, they can be extended to 2–3 cm beyond the shell margin, whereas the siphons of *C. regab* n. comb. hardly

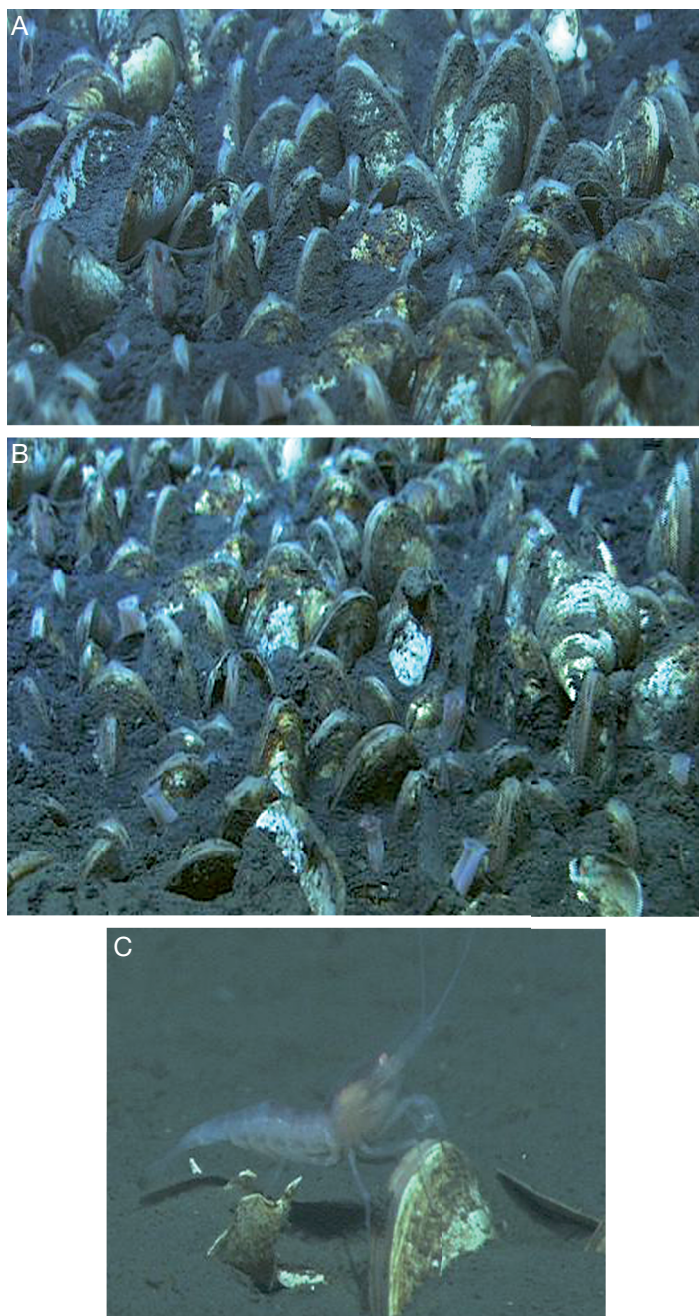


FIG. 9. — *In situ* images of *Christineconcha regab* (Cosel & Olu, 2009) n. comb. and *Laubiericoncha chuni* (Thiele & Jaeckel, 1931) from the SW of REGAB, cruise GUINECO, (P. I.: A. Boetius), RV *Meteor* Dive 225, site 3, 16.VIII.2008: **A**, field with almost exclusively *Christineconcha regab* n. comb.; **B**, *C. regab* n. comb. with some *Laubiericoncha chuni* scattered in between and recognizable by the tubular siphons and the fully buried shell, on the right is a specimen of *Phymorhynchus coseli*; **C**, the shrimp *Alvinocaris muricola* Williams, 1988, trying to feed on the pseudofaeces of *C. regab* n. comb. (this photograph from another site at REGAB, 19.VIII.2008, same cruise). Images courtesy Karine Olu (IFREMER Brest), © MARUM, Bremen.

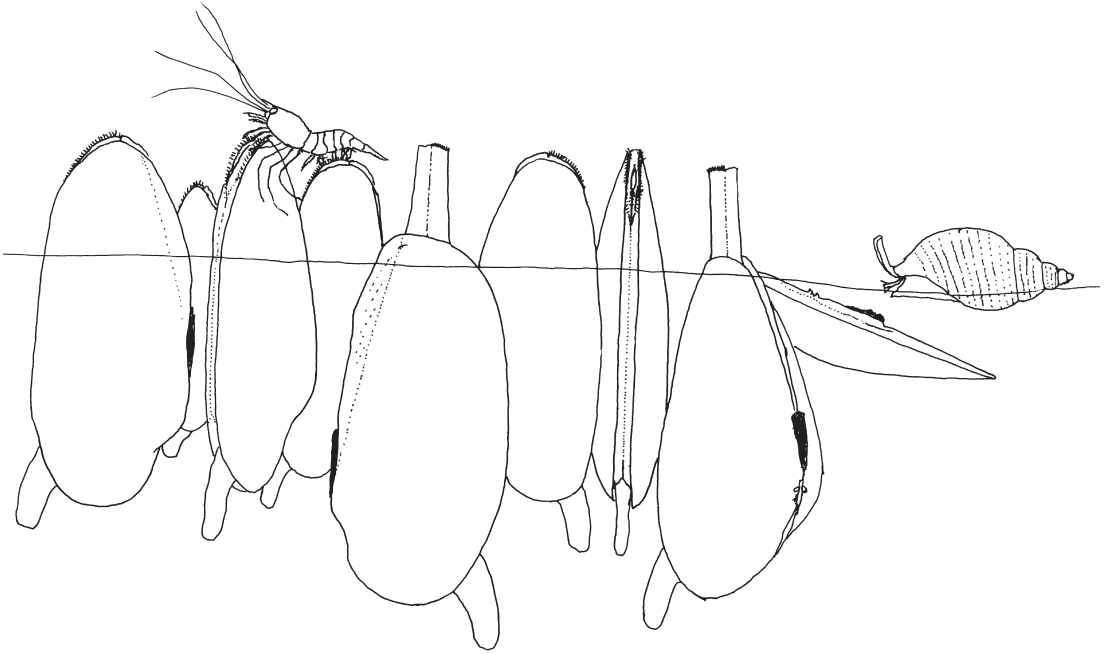


FIG. 10. — Schematic drawing of the *Laubiericoncha*-*Christineconcha*-*Phymorhynchus*-*Alvinocaris* community on the REGAB pockmark. The siphonal openings of both Vesicomysidae are on the same level over the sediment surface.

surpass the posterior and postero-ventral shell margin (Figs 5C; 9A). Both species being situated vertically side by side (Fig. 10), *C. regab* n. comb. is buried in the sediment with the anterior half or two thirds of the shell, with the posterior part sticking out into the free water (in monospecific clam beds, *C. regab* n. comb. may also be buried more deeper (Olu-Le Roy, pers. comm.). On the contrary, *L. chuni* is completely buried, and only the extended siphonal tube and perhaps the posteriormost shell margin are visible. However, because of the extendibility of the siphons, *L. chuni* is able to take respiration water at the same height above the sediment surface or clam bank surface (about 3-4 cm) as *C. regab* n. comb.. As *L. chuni* is buried deeper in the substrate, with the extended foot it can reach the sulphides deeper in the sediment. In fact this species is found on sites where seepage is rather feeble whereas *C. regab* n. comb. lives and always dominates or is exclusively present on sites with higher concentration of sulphides and stronger seepage. Quite probably the short siphons of *C. regab* n. comb., which can be better protected

by the shell are an adaptative feature for living on sites with such a high sulphide concentration.

Measured data on sulphide concentration in the agglomerations of the two vesicomysid species are not yet available. However, Olu-Le Roy *et al.* (2007) mention that "first environment characterisation suggested that "*C.*" (s.l.) *regab* can be associated to higher methane fluxes than *Laubiericoncha chuni* (4.4 vs 0.9 mm), which dominates the clusters in the periphery of the REGAB pockmark". This was verified and confirmed during the GUINECO campaign, where *L. chuni* was found present on sites with less active methane emission and so probably also a lower sulphide level (Olu-Le Roy pers. comm.).

Another photograph (Fig. 9C) shows the shrimp *Alvinocaris muricola* (Williams, 1988) at the posterior end of a specimen of *C. regab* n. comb. trying to feed on pseudofaeces of the bivalve. These pseudofaeces consist of undesired particles which enter the mantle cavity with the water current via the inhalent siphon, where they are enclosed by

mucus and transported by means of cilia back to the inhalent siphon and to the free water.

The toxoglossan gastropod *Phymorhynchus coseli* Warén & Bouchet, 2009 also occurs on these vesicomylid beds and is visible on photographs (Fig. 9A; see also Cosel & Olu 2009: figure 30e). The genus *Phymorhynchus* is known to feed on *Bathymodiulus* (Warén & Bouchet 2009: 2344) but its presence near and at the vesicomylid banks suggests that it may also feed on the Vesicomylidae. Partial nutrition on vesicomylids is also suggested by a stable isotopic study indicating that signatures of both *Phymorhynchus* and vesicomylids are very close (Olu *et al.* 2009).

DISCUSSION

In morphology, *Christineconcha* n. gen. is close to *Abyssogena* Krylova, Sahling & Janssen, 2010. Like *Abyssogena*, the new genus has a thin-walled elongate shell with narrow hinge line. In both genera, the pallial line originates from the ventral margin of the anterior adductor scar and there are additional pallial scars above it. In both genera, only the inner demibranch is present, with interlamellar septa consisting of separate files, or cylindrical channels (Krylova *et al.* 2010). Nevertheless, *Abyssogena* is distinguished from *Christineconcha* n. gen. by the radiating arrangement of the hinge teeth, full reduction of the cardinal 3a in the right hinge and by the presence of the very small and irregular indentation in the posterior margin of the pallial line interpreted as an indication of a pallial sinus. In *Christineconcha* n. gen., the anterior adductor scar is relatively smaller and situated more dorsally compared with the larger circular and more ventrally situated scar in *Abyssogena*. In this genus, the pallial line runs from its insertion point directly towards posterior and in its first third divergent from the shell margin (see Fig. 7A-C), whereas in *Christineconcha* n. gen., it is parallel to the shell margin, running from the insertion point at first ventrally and curving backwards along the anterior and ventral margin. The most important anatomical difference of *Christineconcha* n. gen. from *Abyssogena* and from other described vesicomylids is the presence of two pallial apertures instead of three.

With its elongated shell outline *Christineconcha* n. gen. resembles three other vesicomylid genera: the recent *Ectenagena* Woodring, 1938, and two fossil genera, *Pleurophopsis* Van Winkle, 1919, and *Adulomya* Kuroda, 1931 (Table 3). From these, *Christineconcha* n. gen. differs by the pallial line originating from the ventral margin of the anterior adductor scar and running parallel to the anterior and ventral margin, a feature reflecting the organization of the muscles of the pallial complex. In *Pleurophopsis*, the pallial line inserts more posteriorly in the anterior adductor scar (Fig. 8D). In contrast to the new genus, *Ectenagena* has two demibranchs and a well-developed pallial fusion under the inhalent siphon.

The reduction of the outer demibranch is widely distributed amongst the vesicomylids. Including *Christineconcha* n. gen., six genera are now known, in which only the inner demibranch is present: *Isorropodon* Sturany, 1896, *Calyptogena*, *Abyssogena*, *Wareniconcha* Cosel & Olu, 2009 and *Elenaconcha* Cosel & Olu, 2009 (Cosel & Salas 2001; Krylova & Sahling 2006; Cosel & Olu 2009; Krylova *et al.* 2010). Moreover, these genera have in common the absence of dendritic processes on the vulva in the inhalent siphon, a very small or completely absent pallial sinus and the absence of the deeply-located anterior lamellar ligament forming the so-called “subumbonal pit”.

Molecular data for representatives of this genus group exist for *Calyptogena* and *Abyssogena* only (Peek *et al.* 1997, 2000; Kojima *et al.* 2004); genetic analysis of *Christineconcha* n. gen. is currently under way. Unpublished results from the mitochondrial CO1 gene confirm that *Christineconcha regab* n. comb. is not related to any other Pliocardiinae including *Calyptogena* and *Abyssogena* spp. previously sequenced, neither to the other species from the Gulf of Guinea (Decker, Olu & Arnaud-Haond, unpubl. data). Analyses of other genes including ITS are in progress.

Christineconcha regab n. comb. is presently known from widely separated localities on the continental margin of Africa and Europe from the Gulf of Guinea to the Gulf of Cadiz and the Gulf of Gascony (Cosel & Olu 2009; C. F. Rodrigues & M. R. Cunha pers. comm.). In the Gulf of Guinea, *C. regab*

n. comb. lives on active pockmarks with cold seeps. In the Gulf of Gascony, reducing biotopes have not yet been discovered, but the record of *C. regab* n. comb. undoubtedly indicates that they exist. The vertical range of *C. regab* n. comb. is quite probably limited to the abyssal zone (2800–4000 m). For the moment, the genera *Christineconcha* n. gen. and *Elenaconcha* are the only known endemic Atlantic genera in Pliocardiinae.

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